DEVELOPMENT OF A MOTORIZED CUTTER (ELECTRO-MECHANICAL PART) AND INTEGRATION SYSTEM

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SUPERVISOR'S DECLARATION

"I hereby declare that we have checked this project and in my opinion this project is satisfactory in terms of scope and quality for the award of the degree of Diploma of Mechanical Engineering"

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STUDENT'S DECLARATION

I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duly acknowledged. The thesis has not been accepted for any degree and is not concurently submitted for award of other degree.

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DEDICATION

To my beloved parents, Mr. Ismail Bin Ainuddin and Mdm. Noridah Binti Harun, other siblings, family and friends, without whom and his/her lifetime efforts in encouraging and supporting my pursuit of higher education in Mechanical Engineering. Not forgotten to all staff of Faculty of Mechanical Engineering form University Malaysia Pahang especially my supervisor, Mr. Shahmi Bin Junoh@Yacob for giving me this opportunity and providing conducive environment in completing this project.

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ABSTRAC

A motorized cutter been designed to use in harvesting fresh fruit bunches especially during fruit season. The main reason for the motorized cutter been designed is to make it easier for the users or consumers operating the cutter without using high energy. The motorized cutter had been support with 24V DC motor, 24V rechargeable battery, cable and other electrical components. H-bridge concept being used in electrical circuit so that the motor rotor can rotate clockwise or anti clockwise when the push button is pressed.

ABSTRAK

Sebuah pemotong bermotor dibuat khas untuk digunakan ketika mengait buah yg sudah masak terutama pada musim buah. Tujuan utama pemotong bermotor ini direka untuk memudahkan para pengguna untuk mengait buah-buahan tanpa menggunakan tenaga yang tinggi. Pemotong bermotor ini dilengkapi dengan sistem elektrik dimana menggunakn 24V DC motor, 24V bateri caj, kabel dan juga komponen-komponen elektrik lain yang juga turut digunakan. Konsep H-bridge digunakan dalam litar elektrik bagi memudahkan motor berpusing mengikut lawan jam atau arah lawan jam apabila butang suis ditekan.

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LIST OF ABBREVIATION

MIG	**Metal Inert Gas**
DC	**Direct Current**
AC	**Alternating Current**
LED	**Light Emitting Diode**

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION FOR MOTORIZED CUTTER

A cutter for harvesting fresh fruit bunches and pruning fronds is easier to find in the current market nowadays. It has been used for a long time ago especially during fruit season such as rambutan season. Therefore with our modern technology, a new motorized cutter have been created so that make it easier to the farmer in collecting fruit bunches and pruning fronds. A motorized cutter was driven by (DC) motor when operating it. The other component uses in motorized cutter are battery, LED, resistor, cable and aluminium plate (motor casing).

1.1.1 INTRODUCTION TO DC MOTOR

A DC motor is an electric motor that runs on direct current (DC) electricity. A DC motor works by converting electric power into mechanical work. This is accomplished by forcing current through a coil and producing a magnetic field that spins the motor. The simplest DC motor is a single coil apparatus, used here to discuss the DC motor theory.

The voltage source forces voltage through the coil via sliding contacts or brushes that are connected to the DC source. These brushes are found on the end of the coil wires and make a temporary electrical connection with the voltage source. In this motor, the brushes will make a connection every 180 degrees and current will then flow through the coil wires. At 0 degrees, the brushes are in contact with the voltage source

and current is flowing. The current that flows through wire segment C-D interacts with the magnetic field that is present and the result is an upward force on the segment.

The current that flows through segment A-B has the same interaction, but the force is in the downward direction. Both forces are of equal magnitude, but in opposing directions since the direction of current flow in the segments is reversed with respect to the magnetic field. At 180 degrees, the same phenomenon occurs, but segment A-B is forced up and C-D is forced down. At 90 and 270-degrees, the brushes are not in contact with the voltage source and no force is produced. In these two positions, the rotational kinetic energy of the motor keeps it spinning until the brushes regain contact.

The brushed DC motor generates torque directly from DC power supplied to the motor by using internal commutation, stationary permanent magnets, and rotating electrical magnets. Advantages of a brushed DC motor include low initial cost, high reliability, and simple control of motor speed. Disadvantages are high maintenance and low life-span for high intensity uses. Maintenance involves regularly replacing the brushes and springs which carry the electric current, as well as cleaning or replacing the commutator. These components are necessary for transferring electrical power from outside the motor to the spinning wire windings of the rotor inside the motor

Brushless DC motors use a rotating permanent magnet in the rotor, and stationary electrical magnets on the motor housing. A motor controller converts DC to AC. This design is simpler than that of brushed motors because it eliminates the complication of transferring power from outside the motor to the spinning rotor. Advantages of brushless motors include long life span, little or no maintenance, and high efficiency. Disadvantages include high initial cost, and more complicated motor speed controllers.

1.1.2 INTRODUCTION TO BATTERY

In electronics, a battery is a combination of two or more electrochemical cells which store chemical energy and make it available as electrical energy. Since its invention in 1800 by Alessandro Volta, the battery has become a common power

source for many household and industrial applications, becoming a multibillion-dollar industry.

The name "battery" was coined by Benjamin Franklin for an arrangement of multiple Leyden jars (an early type of capacitor) after a battery of cannons. Common usage has evolved to include a single electrical cell in the definition.

1.1.3 INTRODUCTION TO CABLE

A cable is one or more wires or optical fibers bound together, typically in a common protective jacket or sheath. The individual wires or fibers inside the jacket may be covered or insulated. Combination cables may contain *both* electrical wires and optical fibers. Electrical wire is usually copper because of its excellent conductivity, but aluminium is sometimes used because it is lighter or costs less.

Electrical cables may be made flexible by stranding the wires. In this process, smaller individual wires are twisted or braided together to produce larger wires that are more flexible than solid wires of similar size. Bunching small wires before concentric stranding adds the most flexibility. A thin coat of a specific material (usually tin-which improved striping of rubber, or for low friction of moving conductors, but it could be silver, gold and another materials and of course the wire can be bare - with no coating material) on the individual wires.Tight lays during stranding makes the cable extensible (CBA - as in telephone handset cords).

Bundling the conductors and eliminating multi-layers ensures a uniform bend radius across each conductor. Pulling and compressing forces balance one another around the high-tensile center cord that provides the necessary inner stability. As a result the cable core remains stable even under maximum bending stress.

Cables can be securely fastened and organized, such as using cable trees with the aid of cable ties or cable lacing. Continuous-flex or flexible cables used in moving applications within cable carriers can be secured using strain relief devices or cable ties. Copper corrodes easily and so should be layered with Lacquer.

1.2 BACKGROUND OF THE PROJECT

A motorized cutter is specifically designed to allow us to do further study and have better understanding of flow mechanism during it operation when using 24V dc motor. This new designed of motorized cutter will have high capability in harvesting fresh fruit bunches. The blade is specifically design using patented C-sickle and support with saw cutting blade.

The design of patented C-sickle has been proven to give a higher cutting efficiency and at the same time minimizing the vibration transferred to the body of the operator. When the C-sickle been supported with saw cutting blade make it more easier to the user for harvesting fresh fruit just like using a saw and it is light when handling it.

The operation for motorized cutter been support with 24V dc motor can save time and energy when harvesting fruit. In the electrical circuit, we using H-bridge concept to connect the motor and the battery. When the push button is pressed, the motor will turn clockwise and pull the cable which has been connected with C-sickle and at the same time cut the fruit bunches. While when the push button is pressed for second time, the motor will turn anti clockwise and leave the cable and the C-sickle back at it initial position.

The motorized cutter also using light-emitting diode (LED) which is red and green LED. When the motorized cutter is operating, the red LED will turn on while when the cutter back at it own position or condition, the green LED will turn on. The main reason using different color LED during operating the cutter is to remind us that if there is any electrical current operating or not.

1.3 PROBLEM STATEMENTS

The cutter nowadays does not have dc motor and battery on their operation. It will took a long time to harvesting fresh fruit because it need to do manually when harvesting fresh fruit bunches by using our own energy. It will take a long time

especially for a higher tree. The cutter which easy get in market have a higher in maintenance. When the cutter is been using for a period time, it will easy become malfunction or broken. For examples the blade peel of form the rod, the cable is not durable. So it need a lot of money to do maintenance.

1.4 OBJECTIVES

Objective to the project is firstly to produce an electrical circuit using suitable electrical components, develop and integrate it into the motorized cutter operation. Secondly, understand the operation of motorized cutter when supported by motor.

1.5 SCOPES

Literature review is been done on types of cutter which easy get in market nowadays, types of driven motor and also sheet metal for making motor casing. The motorized cutter is designed using engineering software like SolidWork to draw concepts design for conceptualization process and dimension of finalized concept to provide complete technical drawing. The finalized concept with technical drawing is fabricated using industrial machine and engineering tools. For example, aluminium using to make casing for 24V dc motor. Another software which been using is DXP Protel. DXP Protel been using in making electrical circuit. Examples of electrical components using in this project are battery, LED, motor, battery and push on button. H-bridge concept been using in making electrical circuit followed by solder process while joining method which is MIG welding being used to fabricate the casing with the cutter sing H-bridge concept for electrical circuit.

1.6 PROJECT ORGANIZATION

1.6.1 CHAPTER 2: LITERATURE REVIEW

Initial process of this project started with the literature study for the operation of motorized cutter to acquire better understanding of the importance and function of each

part for motorized cutter. Each special component or design of the studied motorized cutter is listed to future use.

1.6.2 CHAPTER 3: METHODOLOGY

The following process is to determine the objective of the project and monitor the flow of the project. Required components in operating the motorized cutter is chosen based on the objectives. Each dimension of the component is defined using measuring instrument for determining the dimension of fabricated part to allow the component being assembled together. Function for each component have being identified and make it easier during assembly process and operating it.

1.6.3 CHAPTER 4: RESULT AND DISCUSSION

A new motorized cutter which using electrical systems during operation have been designed and built to identify the maximum load occur during harvesting rambutan fruit. Greatest challenge faced in this process when integrating the system and identifying the problems occur when the motorized cutter cannot be operated.

1.6.4 CHAPTER 5: CONCLUSION AND RECOMMENDATION

A new concept and design in operating the motorized cutter was built to improve the current product in market. Further investigation and recommendation for motorized cutter being identified and collect the data can be improved much better in future.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter will provide detail description of literature review done regarding the project title of motorized cutter which is more focusing on their material in use and how it operating. In this literature review, we can see that there are lot types of motor in current market nowadays which can be use in this project. But each of electric motors has differences function and application. They also have their own advantages and disadvantages.

There are also variable types of sheet metal such as copper, aluminium, sheet and etc. Each of them has their own advantages and disadvantages. Same with cutters which also have variable types of it in current market nowadays and have different operation during handle it

2.2 TYPES OF MOTORIZED CUTTER

2.2.1 Wilkinsword Telescopic Universal Cutter

Figure 2.1: Wilkinsword Telescopic Universal Cutter

The Wilkinsword Telescopic Universal Cutter have a few advantages. A top pruner of this cutter is mounted on a lightweight telescopic steel pole that is capable of extending up to 4metres. The bypass blades function via a gear action giving 3 times more cutting power and operate through an integral pulley mechanism. The head can pivot through 240° and can lock at any angle.

2.2.2 Telescopic Tree Pruner

Figure 2.2: Telescopic Tree Pruner

Telescopic Tree Pruner is made using 65Mn high carbon alloy steel saw blade which durable when using it. The blade has 300mm and 2 sided teeth which allow smoothly cutting. It has ground universal pull cut saw blade. The Telescopic Tree Pruner are using double pulley with a 550lb. burst strength rope. Pulley is use in reducing the cutting efforts. It also use Teflon blade coating to reduces cutting friction and resists rust. The handles also can be adjustable. It just need to revolve the handles if want to release or lock the handles. The handles made form strong extendable handles and can be use for trimming branches up to 14'' without a ladder. The connector made using strong ABS plastic which also durable and can be use for a long term. Overall length for this Telescopic Tree Pruner is 1800mm-2800mm.

2.2.3 Fiskars Pruner

Figure 2.3: Fiskars Pruner

Spare yourself the effort of climbing trees to reach far-off branches with this convenient and powerful Fiskars telescoping pruning tool. It uses plastic for body and handles. For the outer pole, it made from fiberglass while the inner pole is made from aluminum. The Fiskars pruner can be extending to a full 12 feet; 1-1/4-inch cutting capacity, allowing trimming upper branches from the safety and security of the ground. Its extremely includes with 15-inch sharp saw cutting blade with attachment which can be manipulated by pulling a rope or the pole's. The head can rotates through 240° for precise cutting angle. Overall length for Fiskars pruner is 95-inches long, for weight is 31 ounces and have lifetime warranty

2.3 TYPES OF MOTOR DRIVE

2.3.1 AC INDUCTION MOTOR (SHADED POLE)

A shaded-pole motor is a type of AC single-phase induction motor. As in other induction motors the rotating part is a squirrel-cage rotor. All single-phase motors require a means of producing a rotating magnetic field for starting. In the shaded-pole type, a part of the face of each field pole carries a copper ring called a shading coil. Currents in this coil delay the phase of magnetic flux in that part of the pole enough to provide a rotating field. The effect produces only a low starting torque compared to other classes of single-phase motors.

These motors have only one winding, no capacitor nor starting switch, making them economical and reliable. Because their starting torque is low they are best suited to driving fans or other loads that are easily started. Moreover, they are compatible with triac-based variable-speed controls, which often are used with fans. They are built in power sizes up to about 1/6 hp or 125 watts output. For larger motors, other designs offer better characteristics.

This photo is of a common C-frame motor. With the shading coils positioned as shown, this motor will start in a clockwise direction as viewed from the long shaft end.

Figure 2.4: Small shaded-pole motor

2.3.2 AC INDUCTION MOTOR

An induction motor (IM) is a type of asynchronous AC motor where power is supplied to the rotating device by means of electromagnetic induction. Other commonly